AP Biology, Semester 2
Unit Test: Plants: Form and Function
Instructor Version

Section I: Multiple-Choice Questions

Answer Sheet

1.	C
2.	D
3.	B
4.	D
5.	A
6.	E
7.	A
8.	D
9.	A
10.	C

11.	B
12.	A
13.	D
14.	B
15.	C
16.	D
17.	C
18.	B
19.	D
20.	D

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Section II: Free-Response Questions

Time Limit: You have 30 minutes to complete this section. Both questions are weighted equally, so allow around 15 minutes for each question. You may move back and forth between questions until time is called.

Scoring: 20 points each, 40 points total

Directions: Answer each of the questions in essay form. Outline form is not acceptable. Labeled diagrams may be used to supplement your answer, but a diagram alone is insufficient. Read each question carefully before you begin to write your answer.

1. **In the process of photosynthesis, light is used to drive the synthesis of energy-rich carbohydrates.**

    i. **How does a plant collect light? What properties of light influence a plant's ability to collect it?**

Plant cells contain special organelles for photosynthesis called chloroplasts. Inside the chloroplasts, antenna complexes are embedded in a system of thylakoid membranes. The antenna complexes contain pigment molecules that absorb specific wavelengths of photons. The photons move electrons in pigment molecules to excited states.

The properties of light that influence a plant's ability to collect it are (1) the light's intensity, or number of photon particles that strike the plant's antenna complexes per unit time, and (2) the wavelengths of the light striking the plant's antenna complexes.

    ii. **What happens to light energy once a plant has collected it? What type of chemical reaction takes place? How is the energy stored?**

The photon's energy is transferred to an electron of a pigment molecule; the electron is moved to a higher energy orbital. The electron's excitation energy is transferred to other pigment molecules until it reaches the reaction center. At the reaction center, the excited electron is transferred to another molecule. This transfer is an oxidation-reduction reaction; the pigment molecule is oxidized and the molecule that accepts the electron is reduced. This reaction converts the energy into a chemical form that's eventually stored in molecules of ATP and NADPH.

    iii. **How does the plant use this stored energy to make carbohydrates?**

The chemical energy stored in molecules of ATP and NADPH is used to drive the reduction of carbon dioxide. Atmospheric carbon dioxide enters a plant through openings called stomata and diffuses into cells where either the Calvin-Benson cycle or the C_4 cycle is initiated. In C_4 plants with the C_4 cycle, carbon dioxide is eventually released and also enters the Calvin-Benson cycle. All carbon dioxide that ends up in carbohydrates is assimilated by the enzyme rubisco—the most abundant enzyme in the world. The Calvin-Benson cycle consists of three phases: fixation, reduction, and regeneration of the starting reactant ribulose-1,5-bisphosphate. Glyceraldehyde-3-phosphate is made and leaves the cycle. Sugars and starch are synthesized from glyceraldehyde-3-phosphate.

2. **You have an apple tree in your backyard. It flowers in the spring and makes apples in the fall. Describe in as much detail as possible, one of the following:**

    i. **the process of gametophyte formation from the flower.**

Cells from the male reproductive structure, the anther, undergo meiosis to form spores as do cells within the ovary of the female reproductive structure. Within the ovary, in the ovule, a cell divides to form four haploid spores. One of the four female spores (called

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megaspores) undergoes mitosis to form eight nuclei followed by cell wall formation. Three antipodal cells are at one end; and three cells, one egg and two synergids, are at the other end; and one cell with two nuclei is in the middle called the mother cell. These cells make up the embryo sac, which is the female gametophyte.

The male spore divide to form one tube cell and one generative cell. A wall develops around the cells to form a pollen grain, which is the male gametophyte.

ii. the processes of pollination and fertilization.

The pollen grains from the male anther are dispersed by the wind and by insects. When a pollen grain lands on receptive female stigma, it is retained because the stigma is sticky. If the female stigma is of the right genetic species, the pollen grain germinates and the tube cell grows through the style to the ovary where it penetrates the ovary near the synergid cells. Two sperm cells are delivered by the tube cell and a double fertilization occurs: one sperm cell fertilizes the egg cell; the other joins the diploid mother cell.

iii. the process of seed and fruit formation from the zygote.

The zygote undergoes mitosis to form two cells. One cell goes on to become the embryo and the other cell, the suspensor. The embryo cell divides to form a heart-shaped embryo and the suspensor grows and pushes the embryo into the endosperm. One or two seed leaves grow, and the embryo develops other plant organs. Water is lost and a protective seed coat forms. At the same time that the seed is forming, the ovary around the seed or seeds develops into the fruit. The fruit may also contain other parts of the flower and nearby structures.

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